

# Agentes Autónomos e Sistemas Multi-Agente (AASM)

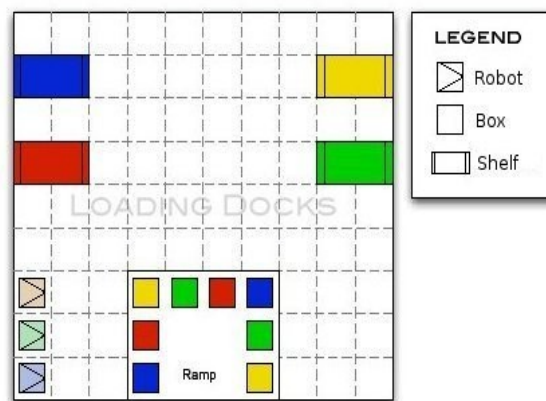
Ano Lectivo 2007/2008

## Laboratory 1 – Introduction to Multi-Agent Systems

### 1 Loading Docks

The *Loading Docks* presents a scenario where some autonomous robots are used to store boxes in corresponding shelves in a warehouse. Boxes are loaded into a central ramp and should be stored according to their colour. (e.g. Blue boxes should be stored in blue shelves).

The warehouse is represented by a rectangular grid and every object in the environment has a regular form (including the robots) and are mapped into grid units. Figure 1 illustrates the initial situation of Loading Docks.



**Figure 1** – The Loading Docks initial setting.

This scenario have four type of entities:

1. **Robot:** it is represented in the environment as an autonomous agent. It can pick up boxes, carry them and store them in a shelf. The robot can only operate boxes that are in front of it. Additionally, the robot can move one cell forward (if it is free) and rotate in 90° steps (left and right). The robot sensors are limited as it can only sense its current cell and the cell in front of it.
2. **Ramp:** it is a static object that holds boxes. Robots cannot move through the ramp. It initially holds 8 boxes of four different colours.
3. **Shelf:** it is a static object characterized by a colour where boxes can be stored. The environment has 4 shelves with 4 different colours (red, blue, green and yellow). Each shelf contains two holding compartments, thus it can hold up to two boxes.
4. **Box:** it is a static object that can be carried by the robots. It is characterized by a colour.

The agent can move one cell at a time, in the direction it is facing. However, it cannot move to an occupied cell or go outside the warehouse's limits. As said before, the agent can turn and change it's direction 90° left or right.

An agent that it's not carrying any box can pick up a box if the box is standing in the cell in front of him. An agent can carry one box at a time and can only drop it in the corresponding shelf (they cannot drop a box in

the middle of the warehouse). Agents cannot exchange boxes. To store the box in the shelf, the agents needs to be facing an empty shelf of the corresponding color.

The robots' goal is to store all boxes in the corresponding shelves and then return to their initial position. They can only carry one box at a time, cannot drop boxes in the warehouse's floor and cannot exchange boxes.

## 2 Exercise

After careful reading of the description of the Loading Docks scenario, discuss the following questions:

1. How do you characterize the environment? Is it accessible? Discrete? Dynamic? Deterministic?
2. How do you characterize the agent assuming that it doesn't have internal state?
3. What are the agents' sensors and effectors?
4. What rules should a reactive agent have in order to solve the problem? Remember, it cannot have internal state. Rules should take the form `<sensor-state>* -> <action>`.
5. What are the problems of the this solution?
6. How can you improve the reactive solution given to 4 if you add an internal state?